# SAFETY OF LIFE AND PROPERTY AT SEA

## HEARING

BEFORE THE

## SUBCOMMITTEE ON MERCHANT MARINE AND MARITIME MATTERS

OF THE

## COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE

## UNITED STATES SENATE

EIGHTY-SECOND CONGRESS

SECOND SESSION

ON

SAFETY OF LIFE AND PROPERTY AT SEA—TO INVESTIGATE THE RECENT MARITIME DISASTERS AND TO RECEIVE EVIDENCE AND RECOMMENDATIONS FOR THE IMPROVEMENT OF OUR SAFETY-AT-SEA STANDARDS

APRIL 4, 1952

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# CONTENTS


Statement of— Page

Brown, David P., vice president, mechanical program, American Bureau of Shipping, 45 Broad Street, New York, N. Y. 27

Cochrane, E. L., United States Maritime Administrator, Department of Commerce, Washington, D. C. 1

Green, Walter, president, American Bureau of Shipping, 45 Broad Street, New York, N. Y. 26

Malone, V. J., president, Marine Firemen's Union, 150 Broadway, San Francisco, Calif. 28

Shepheard, H. C., Rear Admiral, Office of Merchant Marine Safety, United States Coast Guard, Washington, D. C. 21

Wright, E. A., Captain, United States Navy, Chief, Hull Design Section, Bureau of Ships, Washington, D. C. 25

Letter from—

Shepheard, H. C., RADM, USCG, Chief, Office of Merchant Marine Safety, dated, March 20, 1952, to Mr. D. P. Brown, American Bureau of Shipping, 45 Broad Street, New York, N. Y. 21

New York Times article, dated March 26, 1952 24

# SAFETY OF LIFE AND PROPERTY AT SEA

**FRIDAY, APRIL 4, 1952**

UNITED STATES SENATE,
SUBCOMMITTEE ON MERCHANT MARINE AND
MARITIME MATTERS OF THE COMMITTEE ON
INTERSTATE AND FOREIGN COMMERCE,
*Washington, D. C.*

The subcommittee met, pursuant to call, at 2:50 p. m., in room 457, Senate Office Building, Senator Warren G. Magnuson, presiding.

Also present: Halford Davis, professional staff member, and John Butz, executive secretary.

Senator MAGNUSON. Now the other matter that we want to take up is safety of life and property at sea, which involves these recent crack-ups.

Our first witness is Admiral Cochrane.

I know you are a very busy man. We will be glad to hear from you.

I want to make this preliminary statement on this matter. There is no legislation before us on the matter of safety of life and property at sea, but in view of the fact that recently we have had quite a few disasters due to crack-up of ships, it was deemed wise that the Senate committee get some information on the matter from those that might be able to tell us why this is happening.

I also want to say that if what has happened in the last 6 months is any criterion of what may happen in the future, I suspect that it might get worse as the ships become more obsolete, and, therefore, it seems to me that it is the best argument that we have for the passage of a long-range shipping bill. We might get some ships that do not crack up.

I might say for the benefit of those interested in shipping here that the House has finally scheduled hearings for the long-range shipping bill to be held, I believe, to start April 22, and we hope they will get through with them and get it on the floor and get it passed.

Admiral Cochrane, you are an old-time shipbuilder and shipping expert. I do not know what this committee could do about it, but maybe you could tell us briefly what you think the reason is for these crack-ups.

Is it overloading, is it the controversy between riveting and welding, or what is it?

## STATEMENT OF VICE ADM. E. L. COCHRANE, MARITIME ADMINISTRATOR, DEPARTMENT OF COMMERCE, WASHINGTON, D. C.

Admiral COCHRANE. Mr. Chairman, I do not have a prepared statement. I want to open my remarks by saying that the ships with which we are having difficulties today, I think I could say without fear of exaggeration, are exclusively of the war-built ships.

During the war we did break into the construction of welded ships, with a great deal of vigor.

I served on a committee appointed by Colonel Knox back in 1943 when trouble first began to develop among those ships, a committee of men from the Navy, Maritime, Treasury, that is, the Coast Guard and from the American Bureau of Shipping, which, of course, was responsible for the approval of the designs of the ships in the first place.

And we came unqualifiedly to the conclusion that had the decision not been both in the Navy and in the Maritime Commission as of that day to go into building welded ships that the astounding records in numbers of ships and in the speed with which they were built, which were both vital to the successful completion of the war, could not have been accomplished.

I am still strongly of that conviction, and I believe that any difficulties which have occurred here recently with welded ships should not be permitted for one moment to raise any question as to the validity or the wisdom of the decision to build them.

Senator MAGNUSON. In other words, as I recall, at that time, although there must have been, as I say, some controversy over the welding of these ships, the advantages of getting the ships done, the needed ships, far outweighed that matter.

Admiral COCHRANE. It tremendously outweighed it. The fact that these ships did serve and that we did get the war over more quickly than we had even hoped, was due in no small measure to that decision.

Difficulties did begin to develop among these ships fairly early in the Liberty ships first, and steps were taken to investigate why that was going on, and it was discovered it was due to several things.

One, it was due to the fact that we were using steel in welded ships such as we had used previously in riveted ships, steel in which new characteristics which had not heretofore been experienced did show up.

The steel was somewhat brittle in low temperatures, and somewhat brittle under the effects of welding.

Two, there were some structural details the designs of which were not developed as we know now they should have been.

Those were corrected, and the experience in the modifications of the Liberties has been astonishingly satisfactory, particularly. The T–2 tankers at that time were larger and faster than their predecessors. There were over 500 ships built of that T–2 design. Some showed difficulties which were very disconcerting, to say the least.

The ships did break in two suddenly, in some cases, while in port even.

Study was given to that and it was believed that a solution had been found in preventing the spread of cracks which could cause the loss of the ship by breaking in two. Riveted strapping was ordered under the joint aegis of the Coast Guard and of the American Bureau of Shipping and did prove somewhat effective.

Further study has been directed to that subject. During this past bad winter, several very distressing tanker catastrophes have occurred, which indicated that further steps were necessary.

This committee of which I spoke, appointed originally by Colonel Knox, has been perpetuated in the so-called five agency committee. It has been working on the problem. The Coast Guard has been

working on it diligently. The American Bureau of Shipping, of course, has given it continuous attention.

It is true that these recent casualties have shown a different pattern from those which turned up earlier.

Senator MAGNUSON. Where did these recent ones crack, in the same position?

Admiral COCHRANE. Nearly amidships.

Senator MAGNUSON. The old Liberties used to crack right ahead of the bridge.

Admiral COCHRANE. Yes, but the cracks in that case almost all originated from the corners of the hatches of the main cargo hatches, the corners of which were originally quite sharp and square, but those have been take care of pretty well.

The pattern of the cracking has been much less uniform in the tankers, less uniform and consistent.

Some evidence exists that the bilge keels as originally fitted were causing difficulty. Earlier alterations were ordered and a good many bilge keels have been modified, but it is the opinion now, I believe, although there are men from both the Coast Guard and the American Bureau here who can testify as to the details of that, that those modifications were not quite adequate.

Senator MAGNUSON. You say again that the general opinion was that the modifications were not quite adequate?

Admiral COCHRANE. That is correct. Decisions have recently been made actually within the week to require some further work on the T–2 tankers. The American Bureau representatives and the Coast Guard can testify to that.

Senator MAGNUSON. They can testify about that?

Admiral COCHRANE. Yes.

The question of the loading of the tankers has come up too. There is great reluctance particularly by the American Bureau of Shipping to specifying the loading because that is not their field, but I believe it is quite the general consensus of opinion that much can be done to minimize the strains that are brought to ships' hulls by more careful determination of the distribution of load, and the distribution of ballast. In other words, the way the ships cargo is handled.

Senator MAGNUSON. Generally speaking, are not the tankers carrying many more barrels now than they did 2 years ago in the past?

Admiral COCHRANE. They are, of course, busier than they were, but they have all limits to the amount of load that they carry. They have "load lines" assigned below which they cannot be loaded, no matter whether it is heavy oil or aviation gasoline.

Senator MAGNUSON. I recall some information that it was not so much a question of the over-all amount of barrels, but the placement within the tanker, the distribution.

Admiral COCHRANE. The distribution of the cargo fore and aft in the ship. That is quite important. Of course, it is also important that the bulkheads should not be exposed to too much pulsing load from the slushing around of liquids in partially fitted tanks too.

Unquestionaly when the ships are caught in cold, severe weather, the quality of the steel that was used in the war-built ships introduce more difficulties is more fraught with danger than is the steel that is in the ships that have been built recently.

I want to say that out of these studies that were made from the war experience and the experience immediately postwar, new rules have been developed so that the ships that are now being built have proved quite sound so far, fortunately, and I had better knock on wood, quite free from trouble. And the adaptation of welding to ship building is clearly recognized not only in this country, but has been accepted by those abroad who first thought they were quite clever not to have adopted it as quickly as we did.

Senator MAGNUSON. Thank you, Admiral. I have no more questions.

Admiral COCHRANE. Thank you.

Senator MAGNUSON. We have Admiral Shepheard of the Coast Guard, who is chief of the Office of Merchant Marine Safety.

We will be glad to hear from you.

Admiral SHEPHEARD. Senator Magnuson, I prepared a brief historical background on this subject, and with your permission I would like to submit it for the record.

Senator MAGNUSON. Yes, I would be glad to have you do so.

Admiral SHEPHEARD. And then give you a summary of that brief.

(The document entitled, "Report on Merchant Ship Structural Failures," is as follows:)

REPORT ON MERCHANT SHIP STRUCTURAL FAILURES—UNITED STATES COAST GUARD, APRIL 4, 1952

The recent disastrous breaking in two of the T–2 tankers *Fort Mercer* and *Pendleton*, with a combined loss of life of 14 calls very sharp attention to the ship-fracture problem.

Serious cracking and breaking in two of ships were not unknown prior to the introduction of welded ship construction, but since the problems associated with present-day ship fractures are related almost wholly to welded construction this report will deal only with fractures which have been experienced since the general adoption of welded construction in the United States.

Small all-welded vessels were constructed as early as 1930 and in November 1937, a large all-welded tanker was launched by the Sun Shipbuilding Co. This vessel was followed by six sister ships.

By the time of the entry of the United States into the Second World War, welding had reached wide adoption in shipbuilding but all-welded construction was not at all general, appreciable riveting being retained at most shipyards. However, very severe ship losses by enemy submarine action very soon demanded the utmost in rapid ship construction. Experience with welding had demonstrated that appreciable savings in time could be effected by its use. What was possibly more important, welders could be trained more rapidly than riveters and a less robust physique was required, so that women welders became not uncommon. Because of these considerations, all-welded construction was very rapidly adopted at a majority of the existing shipyards and was universally adopted by the new shipyards. In both new and older shipyards subassembly and other technique were rapidly developed which further increased the rate at which ships could be built. As a result, notwithstanding war losses, the number of American merchant vessels of 1,000 gross tons and up in actual service (excluding vessels operated by the armed services) increased from approximately 1,300 at the end of 1942 to approximately 2,200 a year later, and further increased to about 3,200 by the end of 1944. (The total number of merchant-type ships actually built between the end of 1942 and the end of 1944 was approximately 2,800).

Even if all-welded construction had been a well-established general practice prior to this construction program, some difficulties could have been expected as a result of the pressure for rapid ship construction and the "spreading thin" of existing "know how." Experience in the years since has demonstrated how very thin that "know-how" was, and that considerable is yet to be learned.

The two types of vessels constructed in the largest numbers and which have experienced the greatest number of structural failures are the Liberty-type cargo vessels and the T–2 tankers. The first Liberty ships went into service near the

end of 1941 and the first T–2 tankers (T–2–Se–A1 type) went into service in the latter part of 1942. Up until January 16, 1943, 10 serious fractures had been experienced in Liberty ships and two other design cargo ships suffered serious fractures, but none of these had broken in two. On January 16, 1943, the T–2 tanker *Schenectady* in ballast condition, lying at her builder's dock after return from a trial trip, suddenly and without warning, fractured her deck, sides, and longitudinal bulkheads and jackknifed. The very violent fracture occurred with a report heard at least a mile.

The occurrence of this violent fracture without any stress of sea dramatically and urgently focused attention to the fracture problem. The circumstances surrounding the failure were investigated by the Coast Guard, the Maritime Administration, and the American Bureau of Shipping. Suspicion that the vessel may have been overstressed by grounding amidships followed by a fall in water level or that other external agents had been factors, were disproved. A special subcommittee appointed by the American Bureau of Shipping issued a report on March 11, 1943, containing in brief the following opinion relative to the causes of failure:

(*a*) Faulty welding and inadequate attention to welding sequence, combined with poor fit-up and consequent forcing or use of excessive welding. In particular, the weld between the fashion-plate termination and the sheer strake had inadequate penetration and slag inclusions. The chevron pattern indicated this to be the starting point of the fracture.

(*b*) Lack of uniformity in steel and low charpy impact values indicating the steel to be relatively brittle at low temperatures. (Charpy tests, or any other tests for notch brittleness are not a part of the ship-steel specifications.)

(*c*) A bad design detail in that the fashion plate terminated abruptly and did not fair into the sheer strake.

(*d*) Still-water stress due to distribution of ballast, etc., was moderate and was not believed to have contributed to failure as much as high locked-in stresses.

Because of the very serious implications, inherent in the fractures which had occurred in Liberty ships and in this fracture, concerning the adequacy of the Liberty ships and the T–2 tankers then being built at a rapid rate, the Coast Guard acted promptly. On April 3, 1943, the Commandant, Admiral Waesche, addressed a letter to Mr. J. L. Luckenbach, president of the American Bureau of Shipping, requesting that the Coast Guard be kept advised of steps taken by the American Bureau of Shipping with regard to improvements in design and construction, and stating that Merchant Marine Inspection Division inspectors were being instructed to see that requirements and recommendations of the American Bureau of Shipping were complied with. On April 10, 1943, Admiral Waesche addressed a letter to the Secretary of the Navy recommending the appointment of a board of investigation. On April 20, 1943, the Secretary of the Navy appointed the following board to investigate the design and methods of construction of welded steel merchant vessels:

Rear Adm. Harvey F. Johnson, engineer-in-chief, USCG, Chairman
Rear Adm. E. L. Cochrane, Chief, Bureau of Ships, USN.
Rear Adm. H. L. Vickery, Vice Chairman, United States Maritime Commission
Mr. David Arnott, chief, surveyor, and vice president, the American Bureau of Shipping (Mr. J. Lyell Wilson, alternate)

This Board in turn appointed a Subboard having the duty of formulating in detail and of supervising the execution of all phases of investigation as outlined by the Board.

Within the Coast Guard, as part of the Merchant Marine Technical Division, a Structural Subsection was organized to compile and analyze data relative to ship fractures, to maintain cognizance of all related research and developmental data, to examine ship-structural details, and develop recommended design details. This section worked closely with the Subboard.

Up until March 29, 1943, a total of 24 serious fractures, including the breaking in two of the *Schenectady*, had occurred. On March 29, 1943, the T–2 tanker *Esso Manhattan*, while in partial ballast condition, in a slight ground swell, suddenly fractured and jackknifed similar to the *Schenectady*. Examination indicated the fracture to have originated in a defective butt weld in the deck.

On May 11 and 12, June 1 and 16, 1943, a special subcommittee of the Committee on the Merchant Marine and Fisheries held hearings relative to the ship fractures which had occurred. At these hearings those concerned indicated that it was believed the causes of these fractures were known and that adequate measures were being taken to prevent them in further construction. Nonetheless, serious fractures continued to occur. On November 22, 1943, the Commandant

98164—52——2

of the Coast Guard issued instructions for reporting of pertinent information relative to structural failures. By the end of January 1944, 64 serious fractures of Liberty ships, including the breaking in two of the *Valeri Chkalov*, had occurred. From data developed from these fractures it was apparent that certain structural details of this class of vessels required correction. Accordingly, on February 15, 1944, the Coast Guard issued requirements for structural alteration of these vessels, involving modifications of the square hatch corners, elimination of the rectangular gangway cuts in the sheer strake, and the provision of bilge keel cut-outs in way of bilge keel butt welds. In order to provide a means for possible limitation of the extent of cracking, longitudinal slots covered by riveted straps were specified to be fitted in the deck just outboard of the hatches, and in the sheer strake just below the deck. An alternative arrangement substituted a riveted gunwale angle for the sheer strake strap. (On later cargo vessels the deck strap was omitted and only the riveted gunwale connection was required.)

As a result of the incorporation of these changes, as well as improvements in the attention paid to the quality of welding, the number of serious fractures in Liberty ships was materially less in the period July 31, 1944, to July 31, 1945, than it had been in the two previous similar periods. Relative to quality of welding, in June 1945, NAVCG 137, entitled "Shipyard Welding Workmanship," was issued as a joint effort of the Coast Guard, Bureau of Ships, Maritime Commission, and the American Bureau of Shipping. This booklet not only contained instructions for correct welding procedure but also contained many illustrations of the types of failures which could result from faulty welds.

During the period of its existence from April 20, 1943, until August 17, 1946, the Board to Investigate the Design and Methods of Construction of Welded Steel Merchant Vessels, acting through its Sub-Board and through associated technical committees carried on a very wide range of investigation including a statistical study of ship failures, a critical examination of design details (including tests of full-scale hatch-corner specimens at the University of California, full-scale ship-bending tests and exploration of stress concentrations, locked-in stresses, low-temperature stress relief, and thermal stresses in service, a theoretical and experimental examination into the fracture properties of steel, a survey of shipyard fabrication processes, a study of operating conditions, and the maintenance of close liaison with the British and other Allied Nations in all phases of this work.

On July 15, 1946, this Board issued its final report containing in part the following pertinent findings:

"(*f*) Twenty-six lives were lost incident to structural failures of welded-steel merchant vessels.

"(*g*) The highest incidence of fracture occurs under the combination of low temperatures and heavy seas.

"(*h*) The age of the vessel has no appreciable influence on the tendency to fracture.

"(*i*) The loading and ballasting systems employed in vessels under study by the Board did not create abnormal bending moments.

"(*j*) No marked correlation between the incidence of fracture on the ships and the construction practices of parent shipyards could be found. However, with due allowance for design, the ships constructed in yards utilizing subaverage shipyard construction practices showed a higher-than-average incidence of fractures.

"(*k*) Only 33 casualties were reported in Victory ships; none of these were serious.

"(*l*) The steel currently supplied for ship construction complies with applicable specifications for ship steel.

"(*m*) Locked-in stresses in the decks of completed vessels are not appreciably reduced in service.

"(*n*) Welding sequence in general has no effect upon the magnitude of residual welding stresses in free subassemblies.

"(*o*)) Every fracture examined started in a geometrical discontinuity or notch resulting from unsuitable design or poor workmanship.

"(*p*) There is a large variation in the notch sensitivity of steel used in welded-ship construction. Steel removed from fractured vessels showed high notch sensitivity."

The Board reached the following conclusions:

"(*a*) The fractures in welded ships were caused by notches and by steel which was notch-sensitive at operating temperatures. When an adverse combination of these occurs the ship may be unable to resist the bending moments of normal service.

"(*b*) The serious epidemic of fractures in the steel structure of welded merchant vessels has been curbed through the combined effect of the corrective measures taken on the structure of the ships during construction and after completion, improvements in new design, and improved construction practices in the shipyards.

"(*c*) Locked-in stresses do not contribute materially to the failure of welded ships.

"(*d*) Existing specifications are not sufficiently selective to exclude steel which is notch-sensitive at ship-operating temperatures.

"(*e*) A tendency for certain ships to incur repeated casualties can be measured but the trend is not great and the effect is not significant.

"(*f*) The basic analytical method used in calculating nominal stresses in the main hull girder under a known bending moment is valid.

"(*g*) The over-all strength of the Maritime Commission ships is satisfactory."

The Board expressed the following opinions:

"(*a*) The results of the investigation have vindicated the all-welded ship. The statistics show that the percentage of vessels sustaining serious fractures is small. With proper detail design, high-quality workmanship, and a steel which has low-notch sensitivity at operating temperatures a satisfactory all-welded ship structure may be obtained. The mechanism of fracture is still not clearly understood, but the investigation has yielded much new information and has contributed to a partial solution of the problem of why welded ships have failed. Until experience can be had with vessels constructed under normal conditions, of improved design, with carefully checked high-quality workmanship, and employing steel of low-notch sensitivity, some form of crack arrestor, such as a riveted gunwale angle, should be incorporated in the hull girder of all large welded vessels.

"(*b*) Notwithstanding the above opinion, the Board considers it imperative to reaffirm the statement that if welded construction in the building of both merchant and naval vessels had not been adopted at the outset of the program, the extraordinary results in speed and volume of construction would have been impossible of accomplishment."

Experience and study since the issuance of this report modifies certain of the findings, in particular with reference to the effect of vessel age and the effect of loading and ballasting procedure. Also, it appears that some reasonable basis for doubt exists relative to the complete validity of conclusion (*c*), and that relative to the design details of the T–2 tanker, and with consideration for the present age and deterioration of these ships, some reservation should be made concerning conclusion (*g*). Concerning conclusion (*d*), ship steel is now procured under a revised specification issued by the American Bureau of Shipping in 1948. This specification, by providing limits of maximum carbon and minimum manganese, is believed to insure steel which, on the average, is more notch-tough than the steel used previous to this specification. It is not known, however, whether, due to variations resulting from rolling procedure, etc., some steel procured under this specification may still be dangerously notch-sensitive and it is considered that a further improvement of this specification would be very desirable.

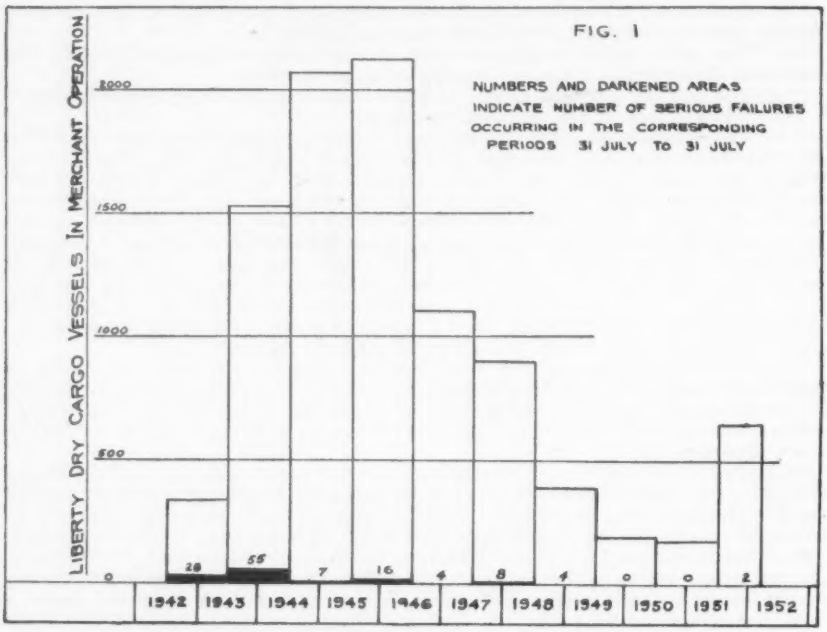
Notwithstanding the exceptions noted and the problems yet remaining, the Board report is considered to have been a very noteworthy contribution to the eventual solution of the welded ship fracture problem.

Shortly after the dissolution of the Board and in accordance with a recommendation contained in the Board report, the Secretary of the Treasury in October 1946 convened a Ship Structure Committee composed of members representing the Army, Navy, Coast Guard, Maritime Commission, and the American Bureau of Shipping. This committee was constituted for the purpose of prosecuting a research program. Partially through the resources of this committee and partially in addition to its work an extensive investigation of the factors influencing structural failures of ships has been in progress. Contributing their efforts to this program have been many of the experts in the leading universities throughout the country, such as the University of California, Massachusetts Institute of Technology, Columbia University, and the University of Illinois. In addition other research organizations such as Battelle Memorial Institute, the National Bureau of Standards, and the United States Naval Testing Laboratories have been active in research of this nature and liaison has been maintained with similar activities being carried on by the British Shipbuilding Research Association, The Admiralty Ship Welding Committee, and other foreign organizations.

These investigations have endeavored to determine the factors influencing the structural failures of ships and they have been carried out in the fields of structural design, fabrication, and materials. The range of investigation includes the study of the basic fundamentals of the fracture mechanisms (which are by no means

understood), the testing of specific ship design details and the testing of full-scale ships.

Earlier in this report a historical view of the ship-fracture record up until early in 1944 was presented. A further examination of this casualty record indicates that the modifications in Liberty ships required at that time, and subsequently, very substantially decreased the number of serious fractures in these vessels. Figure 1 shows diagrammatically the approximate number of Liberty dry-cargo

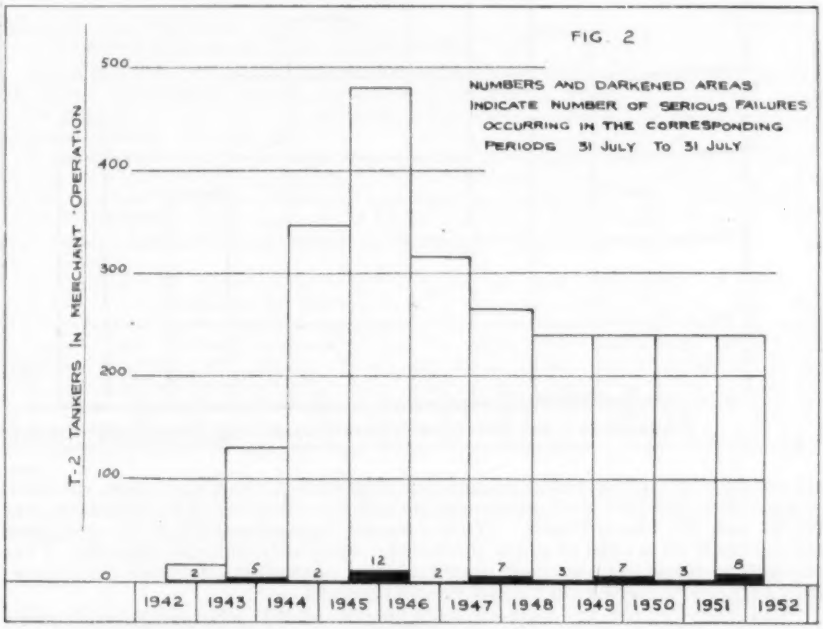



vessels in operation in United States merchant service only for the yearly periods July 31, 1942, July 31, 1943, to July 31, 1951, April 1, 1952, together with the corresponding numbers of serious fractures in each period. Since most fractures generally occur during the winter season the yearly periods are taken July 31 to July 31. Serious fractures are those which are considered to have weakened the main hull girder so that the vessel is in a dangerous condition or is lost. In general, fractures 10 feet or longer in the strength deck, side, bottom, or inner bottom are considered to be serious fractures. It will be noted that for the period before these alterations were undertaken there was approximately 1 serious fracture per year for each 20 to 30 ships. In the subsequent period this was reduced to approximately 1 serious fracture per year for each 100 to 300 ships. For the 2 years July 31, 1949 to July 31, 1951, when the number of Liberty ships in operation was quite small, no serious fractures occurred. From July 31, 1951 to the present, two serious fractures have occurred on United States-flag Liberty ships.

No Liberty ship having a gunwale crack arrester has broken in two and in only one case has such a crack arrester failed to limit the extent of cracking. In the case of the T–2 tankers the picture is not so promising. Although two complete fractures of T–2 tankers, the *Schenectady* and the *Esso Manhattan*, occurred fairly early in the period considered, together with a high percentage of other serious fractures, the number of vessels involved was small compared with the Liberty ships. In addition, the amount of correctible design defects appeared small compared to those of the Libertys. Accordingly, except for correction of the bad fashion-plate detail noted in connection with the *Schenectady* failure, no significant structural alterations were required in the T–2 tankers until May 19, 1947. On December 9, 1947, the T–2 tanker *Ponagansett*, while lying at dock at Boston, Mass., in ballast condition, broke violently in two. On May 19, the American Bureau of Shipping had sent all owners of T–2 tankers a letter requesting the fitting of at least four riveted crack arresters on these vessels. Acting upon the

*Ponagansett* fracture on December 15, 1947, the Coast Guard issued a requirement for the immediate fitting of these crack arresters on all T–2's undergoing overhaul and gas freed and permitting other T–2's to continue operation only on a one-trip basis pending availability of repair yards.

Figure 2 in dicates diagrammatically the approximate number of T–2 tankers in merchant operation over the entire period considered and the corresponding occurence of serious fractures. It will be noted that except for a sharp drop from an

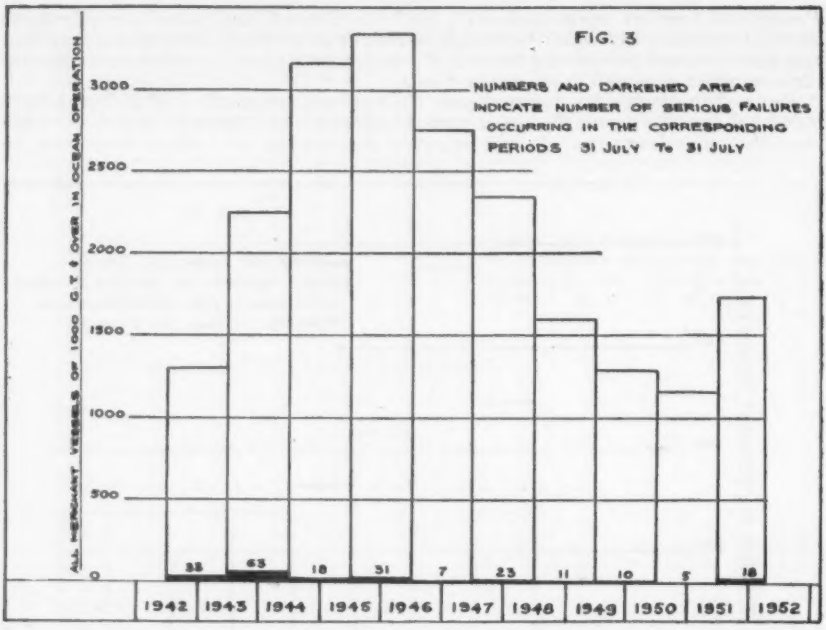



early apparent very high fracture rate (occasioned largely by the very small number of T–2's in operation when the first fractures occurred) there has been no improvement and even an apparent rise in the T–2 fracture rate. Between 1944 and 1946, the average fracture rate was about 1 serious fracture per 60 ships per year. Between 1950 and 1952 the average fracture rate, based on the fractures to date, has been about 1 serious fracture per 45 ships per year.

The fitting of crack arresters had never been expected to have any material effect on the fracture rate, but had been expected to materially lessen the likelihood of complete fracture. The very near breaking-in-two of the T–2 tanker *Oleum* on January 12, 1951, and the recent complete fractures of the strapped tankers *Fort Mercer* and *Pendleton* indicate that the present construction and crack arresters of the T–2's are clearly not adequate.

Figure 3 presents the approximate total number of United States merchant ships of 1,000 gross and over in operation in ocean service together with the corresponding total number of serious fractures for each yearly period. It will be noted that the average fracture rate disregarding variations between individual years appears to have been fairly constant from about 1946 through 1951, but appears to have experienced a definite upswing this winter. It is not known to what extent this may be due to the severity of the past winter. Preliminary data has been obtained from the Weather Bureau, but has not yet been analyzed.

In determining the adequacy of ship structure, the Coast Guard is authorized by law to accept the requirements of the recognized American Classification Society, the American Bureau of Shipping, and in matters affecting the main structure it is the Coast Guard's policy to support the action of the American Bureau when that action is considered adequate. The rules of the American Bureau of Shipping for the building of steel ships have been carefully developed as a result of experience and technical knowledge, and all changes in these rules are carefully considered by the bureau's technical committees, on which are some of




the country's leading naval architects, shipbuilders, and professors of naval architecture, together with representatives of the Maritime Administration, the Navy, and the Coast Guard. When unusual circumstances call for additional requirements on a class of ships, the bureau, after thorough consideration of the problem by the experts on these same technical committees, develops the requirements considered necessary for the vessels involved.

With regard to the T–2 tankers, reference has already been made to the order sent out by the American Bureau of Shipping in 1947 calling for four crack arresters. It was thought at that time that the measure proposed would provide means of preventing complete failure of the hull and that while fractures could still be expected to occur under some circumstances the ships would be able to get into port. The failures of the *Port Mercer* and the *Pendleton* have demonstrated that additional measures are necessary to obtain this objective, and the Coast Guard feels that the American Bureau of Shipping has again taken prompt action in the light of this additional knowledge.

The action of the American Bureau of Shipping will require the T–2 tankers to be provided with the equivalent of four additional crack arresters, and the bilge keel attachment to the shell will be changed to a riveted connection. In addition, an increase in the longitudinal strength of the ship will be required, together with a manual of satisfactory loading and ballasting, both of which will bring about a reduction in the stress level in the main hull girder.

Statements have been published indicating that only a relatively small number of welded ships have been lost as a result of structural failures when compared to the very large number built. This is true from the point of view that the ships were built to do the job of winning the war and this they did with only a minor percentage of casualties. However, from the point of view of safety, the Coast Guard feels that the loss of one ship is a matter of grave concern, particularly so when it cannot be said that all of the factors contributing to the loss are fully understood or recognized.

We know that we have learned a lot since 1943 when the *Schenectady* broke in two, but we also know that we do not yet have all the answers. The knowledge gained by experience, testing, and technical study, is being applied in the design and construction of new ships, and we know that the record of ships built since 1945 has been excellent, but we would be foolhardy to predict that this record will remain perfect in the future. With respect to the ships now eixsting which were built during the war, including the Liberty ships and the T–2 tankers, our

position is not as good since some of the improvements developed, as for example, improved steel specifications, cannot be applied to an existing ship. For those ships the Coast Guard proposed to continue its program of careful analysis of any defects which develop, coupled with prompt action when the need for it is apparent. This, together with research programs to determine the fundamental causes of fractures of ships, should enable us to achieve the standards of safety desired on American ships.

APPENDIX

APRIL 3, 1943.

Mr. J. L. LUCKENBACH,
*American Bureau of Shipping, New York, N. Y.*

DEAR MR. LUCKENBACH: Reference is made to vessels of United States registry of welded construction which, as the result of enemy action or otherwise, have suffered casualty the extent of which may have been influenced by design, method of construction, or both.

It is understood that the American Bureau of Shipping has appointed a committee of experienced authorities on naval architecture and welding, that this committee has submitted its report and that the Bureau has taken the necessary steps with regard to the approval of design plans and with regard to construction and repair methods at shipyard to carry out the recommendations of your committee.

To facilitate the closest cooperation between the American Bureau of Shipping and the Coast Guard in the correction of conditions which may have been contributory to these welded-ship casualties, it is requested that you furnish me with a copy of your committee's report and the steps which have been taken with regard to design and construction to remedy the condition. It is further requested that you keep me currently informed of changes in or additions to this procedure.

In the meantime, inspectors of our Merchant Marine Inspection Division are being instructed to see that the methods and procedures required for the construction and repair of welded ships by the American Bureau are being complied with.

I shall appreciate any other recommendations which you care to make which may further cooperative effort in this matter between the American Bureau of Shipping and the Coast Guard.

Sincerely yours,

R. R. WAESCHE,
*Vice Admiral, United States Coast Guard, Commandant.*

H. C. Shepheard/FCA.

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APRIL 10, 1943.

From: Commandant.
To: The Secretary of the Navy.
Subject: Possible defects in design and construction of welded steel ships.

1. Executive Order No. 9083, dated 28 February, 1942, transferred to the Commandant of the Coast Guard, to be exercised by him under the direction and supervision of the Secretary of the Navy, certain functions of the Secretary of Commerce and the Bureau of Marine Inspection and Navigation, including those pertaining to the approval of plans for the construction of merchant vessels, the approval of materials used in such construction, the classification of merchant vessels, the investigation of casualties involving such vessels, and the issuance of certificates of inspection certifying to the seaworthiness of such vessels. This transfer, in the light of the various statutes vesting specific authority and responsibility in connection with the above matters in such officers of the Department of Commerce, had the effect of imposing upon the Secretary of the Navy and the Commandant of the Coast Guard a direct and primary responsibility for the discovery and correction of any condition adversely affecting the seaworthiness of vessels subject to the inspection laws of the United States.

2. In the discharge of the above responsibility the Coast Guard has conducted investigations of all casualties to such vessels which have occurred since 1 March, 1942, the effective date of the Executive Order No. 9083. The purpose of such investigations is to isolate the causes of casualties and to initiate action designed to prevent the reoccurrence of casualties due to factors which are subject to correction.

3. The investigation, during the past several months, of a number of casualties involving ships of welded steel construction has brought to light a condition which

I believe has serious implications. The report of the investigation in the case of the breaking of the Steamship *Schenectady* while she was tied up to a dock in a west coast port some months ago pointed to structural defects as the cause of the failure and indicated the need for a special study. Such a study was immediately begun and, although it has not been completed, the results to date tend to confirm the finding in the case of the Steamship *Schenectady*. A few days ago the Steamship *Esso Manhattan*, a large tanker, broke in two while proceeding in ballast in quiet waters a short distance off the New Jersey coast. The circumstances surrounding this loss also indicate that structural faults may have caused the casualty.

4. In view of the vital role of merchant shipping in the war effort, particularly from the standpoint of the success of operations under the cognizance of the Navy, and the responsibility of the Secretary of the Navy and the Commandant of the Coast Guard in connection with the seaworthiness of such vessels and safety at sea, generally, it is believed that the developments outlined above not only justify but require that the Navy Department take immediate action in the matter.

5. It is therefore recommended that the Secretary of the Navy designate a board to investigate the designs of, and the methods being followed in the construction of the welded vessels currently being constructed by the shipyards of the Nation, for the purpose of determining what defects, if any, are present in such designs or methods of construction, and to recommend, if defects are found to exist, the measures which should be taken to correct them.

6. It is further recommended that such board be made up of one officer of the Navy, one officer of the Coast Guard and, in view of the vital interest of the United States Maritime Commission in the shipbuilding program, one member to represent that agency, subject, of course, to the approval of Admiral Land, I suggest that the following-named individuals be designated:

Rear Adm. Harvey F. Johnson, United States Coast Guard, Engineer in Chief.
Rear Adm. E. L. Cochrane, United States Navy, Chief, Bureau of Ships.
Rear Adm. H. L. Vickery, United States Navy, Vice Chairman, United States Maritime Commission.

7. There are attached, to facilitate the carrying out of the above recommendations, in the event of their approval: (1) a letter for the signature of the Secretary of the Navy, addressed to the Chairman of the United States Maritime Commission, outlining the problem and requesting his approval of the designation of Admiral Vickery as a member of the board, and (2) a precept, also for signature by the Secretary, establishing the board.

R. R. WAEZCHE.

MEMORANDUM

APRIL 17, 1943.

To: The Secretary of the Navy.
Subject: Board for Study of Possible Defects in Design and Construction of Welded Steel Ships.

1. Supplementing my letter to you of April 10, 1943, on same subject, I conferred with Admiral Land, who later on talked the matter over with Admiral Vickery.

2. Both Admiral Land and Admiral Vickery strongly suggest that a representative of the American Bureau of Shipping be added to the Board and with that exception Admiral Land has advised me that he believes the proposed Board is a proper one.

3. I have no objection to a representative of the American Bureau of Shipping being added to this Board. In fact I am in favor of this additional member. I have therefore revised the original draft so as to include a member of the American Bureau of Shipping, and have also prepared a letter for your signature requesting the President of the American Bureau of Shipping to designate a member of this Board.

R. R. WAESCHE.

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APRIL 20, 1943.

From: Secretary of the Navy.
To: Rear Adm. Harvey F. Johnson, United States Coast Guard, Engineer-in-Chief.
Subject: Investigation of design and methods of construction of welded steel merchant vessels.

1. A board consisting of yourself as chairman, and of Rear Adm. E. L. Cochrane, United States Navy, and, subject to the approval of the Chairman of the United

States Maritime Commission, Rear Adm. H. L. Vickery, United States Navy, Vice Chairman of the United States Maritime Commission, and, subject to the approval of the president of the American Bureau of Shipping, Mr. David Arnott, vice president- chief surveyor, American Bureau of Shipping (Mr. J. Lyell Wilson, assistant chief surveyor, American Bureau of Shipping, alternate), as additional members, is hereby constituted for the purpose of making an investigation into the designs of, and the methods being followed in the construction of the welded steel merchant vessels now being constructed in the various shipyards of the Nation for the purpose of determining what defects, if any, are present in such designs and methods of construction.

2. The board will make a complete investigation of the matter hereby submitted and upon the conclusion of its investigation will report the facts established thereby. If the facts establish the existence of defects in the designs of, or in the methods being followed in the construction of such merchant vessels which in the opinion of the board adversely affect the seaworthiness thereof, the board will also submit its recommendations as to the measures which should be taken to correct such defects.

3. The board is authorized to sit in Washington, D. C., and in such other places in the continental United States as it may consider necessary to the proper discharge of its duties hereunder.

FRANK KNOX.

Copies to:
Admiral Cochrane.
Admiral Vickery.
Mr. Arnott.
Mr. Wilson.

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WASHINGTON, *February 16, 1944.*

To: Officers in Charge, Marine Inspection—Boston; Portland, Maine; Providence; New York; New London; New Haven; Philadelphia; Norfolk; Baltimore; Charleston; Savannah; Jacksonville; Miami; Tampa; New Orleans; Mobile; Port Arthur; Galveston; San Juan; San Pedro; San Francisco; Seattle; Portland, Oreg.; Ketchikan; and Honolulu.

Via: DCGOs, First, Third, Fourth, Fifth, Sixth, Seventh, Eighth, Tenth, Eleventh, Twelfth, Thirteenth (Seattle), Thirteenth (Ketchikan), and Fourteenth Naval Districts.

Subject: USMC Design EC2–S–C1 Liberty type dry cargo ships and tankers—Structural alterations.

1. The enclosed plans give the details of structural alterations which are to be performed on the subject vessels. United States Coast Guard Plan MI 14–S11–17–1 specifies all of the alterations to be performed including the fitting of a reinforcement at the gunwale. You will note that detail C on this plan permits an alternate arrangement consisting of a gunwale bar. The details of this gunwale bar alternate are indicated on Maritime Commission Plan MCE S11–6–4B. It is left to the local authorities to determine on the basis of economy of time and money and availability of materials which of these two alternate reinforcements is to be provided at the gunwale.

2. The attached specification was mutually agreed upon by the Maritime Commission, Navy Department, American Bureau of Shipping, and Coast Guard on February 8, 1944. It lists the various details shown on the plans, and specifies the time at which those alterations are to be made.

3. You are to inform headquarters when these alterations are performed on each vessel. Specify the details of the Coast Guard plan which were applied to the vessel and tell whether a gunwale bar or sheer strap has been fitted.

CHAS. A. PARK,
(By direction).

98164—52——3

FEBRUARY 8, 1944.

## SPECIFICATION FOR ALTERATIONS TO LIBERTY TYPE DRY CARGO SHIPS AND LIBERTY SHIPS CONVERTED TO TANKERS

The following specifications were mutually agreed upon by the Maritime Commission, the Coast Guard, and the American Bureau of Shipping on February 8, 1944:

All Liberty cargo ships and Liberty vessels converted to tankers presently in service shall have the structural alterations made at the time and in the manner described herein, and shown on United States Coast Guard Plan MI 14–S11–17–1 and Maritime Commission Plan MCE S11–6–4B.

(*a*) Vessels which have sustained hull damage serious enough to require extensive repairs shall have these alterations made in addition to the repairs.

(*b*) Vessels which are scheduled to make voyages where low atmospheric temperatures and heavy seas may be expected, such as in the North Atlantic or Gulf of Alaska in wintertime shall have the hatch corners reinforced as per item (A) below, prior to making such voyages, except where extreme military emergency will not permit.

(*c*) All vessels must have all of the alterations completed as soon as possible.

### A. HATCH CORNER REINFORCEMENT

On vessels where a rounded reinforcement has not already been fitted, the corners of Nos. 2, 3, and 4 hatches on the upper deck shall be reinforced in accordance with detail A of drawing MI 14–S11–17–1.

### B. UPPER DECK ALTERATION

A torch cut shall be made in the upper deck plating 28 inches outboard of the line of the hatch side coaming extending from frame No. 40 to No. 143½. The torch cut is to be covered with a double riveted strap in accordance with detail B of drawing MI 14–S11–17–1.

### C. GUNWALE ALTERATION

One of the following alternate arrangements shall be provided:

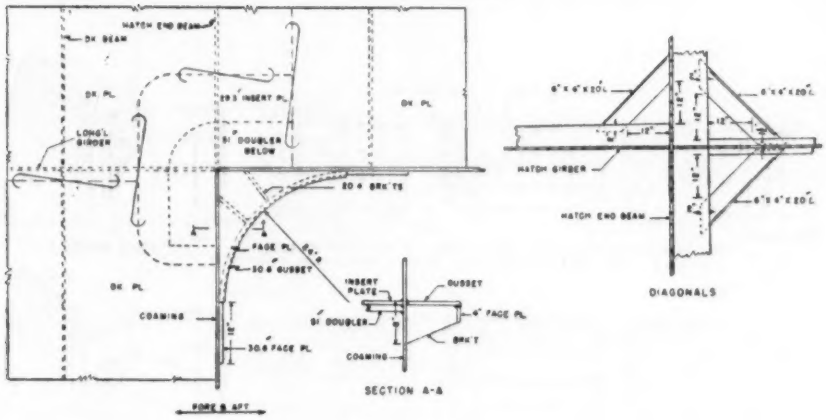
(1) A torch cut shall be made in the stringer plate about 1 inch from the sheer plate and extending from frame No. 29½ to No. 143½. The torch cut is to be covered by a 7 by 6 inch riveted gunwale angle fitted in accordance with MCE Plan S11–6–4B; or

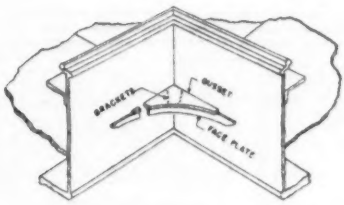
(2) A torch cut shall be made in the sheer strake below the upper deck plating extending from frame 29½ to 143½. The torch cut is to be covered with a double riveted seam strap in accordance with detail C on drawing MI 14–S11–17–1.

### D. BILGE KEEL

For vessels which have continuously welded bilge keels, a 1-inch hole is to be drilled tangent to the shell in way of each butt in the bilge keel. This is to be done at the time of the first docking of the vessel after issuance of this instruction.

## HATCH REINFORCEMENT
## CODE NUMBER 5, 6 & 7




HATCH CORNER LOOKING OUTBOARD

CODE NUMBER 5 --- HATCHES 2, 3 & 4 IN UPPER DK

*U.S. MARITIME COMMISSION MC PLAN EGE-9-C1-S16-2-3 DETAILS 1 & 3
U.S. COAST GUARD PLAN EMM 17-S11-17-1 ALTERATION "A"
U.S. COAST GUARD PLAN MI 15-S11-17-1 DETAIL A
(NOTE: THE U.S.C.G. PLANS, DETAIL A DO NOT INCLUDE DIAGONALS AT THE LOWER FLANGES OF THE BEAMS & GIRDERS)
MOORE DRYDOCK CO. PLAN 9987 DETAILS 1 & 3
BETHLEHEM STEEL CO. S.B. DIV. 56TH ST. BKLYN. PLAN Y-398 DETAIL 1 & DIAGONALS
ARTHUR G. BLAIR INC. PLAN 06A-98 DETAIL A & 3
J.R. JONES CONST. CO. INC., PANAMA CITY (SK-S11-8-46 DETAILS 1 & 3 & Z-SK-S11-8-48 DETAILS 1 & 3
(JONES PLAN SHOWS 51" DOUBLER PLACED ABOVE INSERT PL.)

CODE NUMBER 6 --- NO DIAGONALS, APPLIES TO TRUNKS 3, A, 5, 6 & 7 IN UPPER DK (HATCHES 2, 3 & 4)
U.S. MARITIME COMMISSION MC PLAN Z-ETI-S-C3-S16-2-3 DETAIL 1

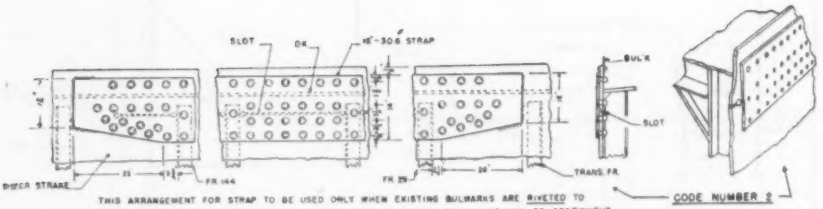
CODE NUMBER 7 --- SIMILAR BUT NO DIAGONALS
HURLEY MARINE WORKS INC. PLAN EGE-30 DOES NOT STATE CORNERS TO BE REINFORCED
NAVY DEPT. BU. OF SHIPS PLAN 017899
NORFOLK NAVY YARD PLAN AX114-S1106-297823, UPPER DK HATCHES 1 TO 5 INC.

NOTES

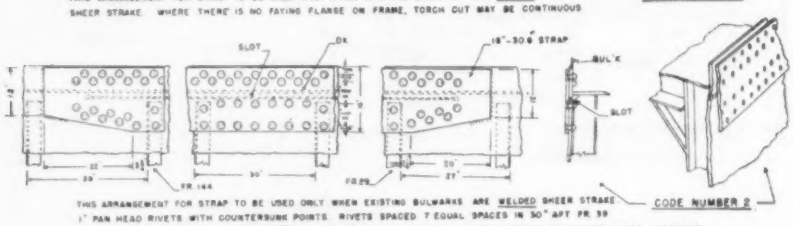
* SOME LIBERTY SHIPS HAVE NO INSERT PLATES AT THE HATCH CORNER
# SOME LIBERTY SHIPS HAVE THE 51" DOUBLER ABOVE DK

*CODE NO. 5 EXACTLY AS SHOWN

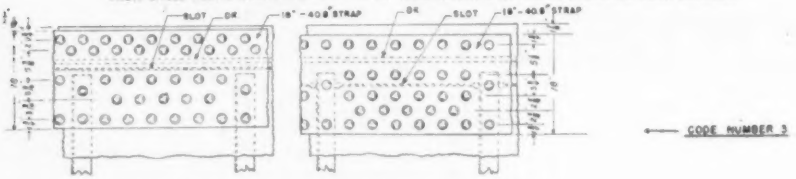
## GUNWALE CRACK ARRESTOR




THIS ARRANGEMENT FOR STRAP TO BE USED ONLY WHEN EXISTING BULWARKS ARE RIVETED TO SHEER STRAKE. WHERE THERE IS NO FAYING FLANGE ON FRAME, TORCH CUT MAY BE CONTINUOUS




THIS ARRANGEMENT FOR STRAP TO BE USED ONLY WHEN EXISTING BULWARKS ARE WELDED SHEER STRAKE 1" PAN HEAD RIVETS WITH COUNTERSUNK POINTS. RIVETS SPACED 7 EQUAL SPACES IN 30" AFT FR 39 RIVETS SPACED 6 EQUAL SPACES IN 27" FWD. FR. 39. GRIND SMOOTH & BURY EXISTING FR. RIVETS WHERE NECESSARY.




18" X 1" STRAP FRS. 87½ TO 108½ FOR VESSELS WITH BULWARK WELDED TO SHEER PLATE

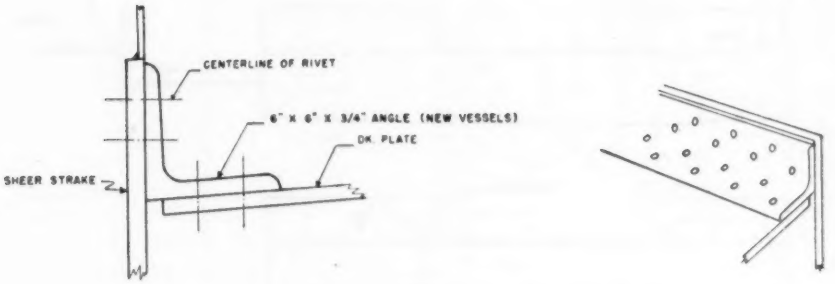
18" X 1" STRAP FRS. 87½ TO 108½ FOR VESSELS WITH BULWARK RIVETED TO SHEER PLATE

CODE NUMBER 2
U.S. COAST GUARD PLAN NO. 165-341-17-1 DETAIL C
ARTHUR G. BLAIR INC. PLAN 268-98 DETAIL C
DELTA S.B. CO. SKETCH M-223

CODE NUMBER 8 ---- IDENTICAL TO CODE NUMBER 2, BUT EXTENDING FROM FR. 38 TO FR. 135
U.S. COAST GUARD PLAN EWB 17-311-17-1 ALTERATION "B"

CODE NUMBER 3 ---- SIMILAR TO CODE NUMBER 2, BUT MIDDLE PORTION 18" X 1" AS SHOWN
U.S. COAST GUARD PLAN NO. 15-311-17-1 DETAIL "C"
WAR DEPT PLAN L1-68-A-R DETAIL "C"

## GUNWALE ARRESTOR

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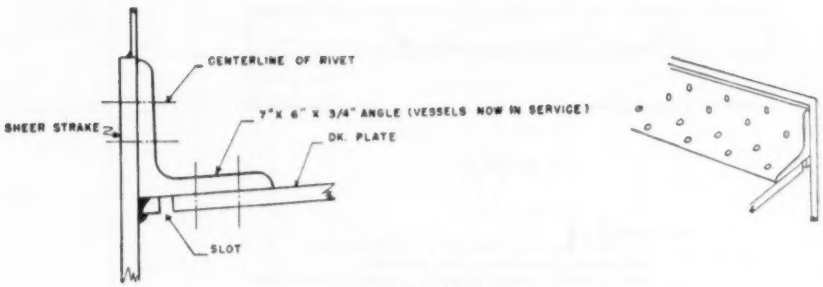


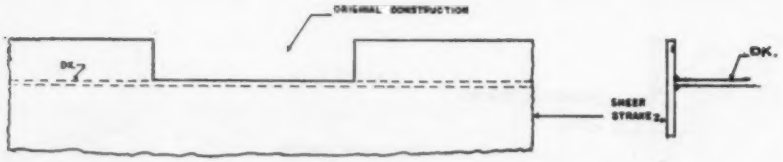

CODE NUMBER 4
&
CODE NUMBER 9

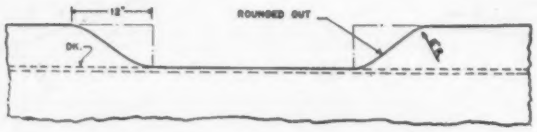
CODE NUMBER 1 -(EXTENDS FROM FR 28 TO 145)
U.S. MARITIME COMMISSION M.C. PLAN EC2-S-C1-S11-6-6
WITH M C PLAN NO. S11-6-4A
DELTA S.B. CO. M C PLAN S11-6-4A
DELTA S.B. CO. PLAN S11-6-3
J.A. JONES, PANAMA CITY PLAN AT11-6-4A

CODE NUMBER 4 - (EXTENDS FROM FR 28 TO 145)
U. S. MARITIME COMMISSION M.C.E. PLAN S11-6-4B

CODE NUMBER 9 -- (EXTENDS FROM FR. 38 TO 135)
U.S. COAST GUARD PLAN EMM17-S11-17-1 ALTERATION "B"

## GUNWALE ALTERATION

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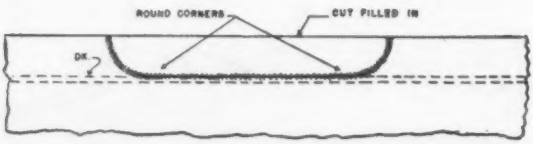
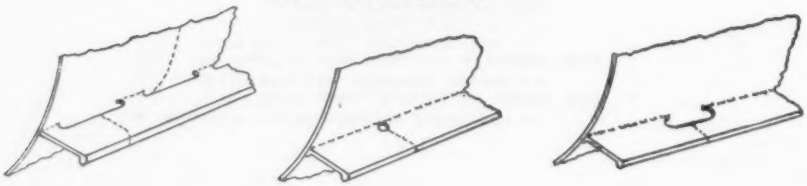



CODE NUMBER 6

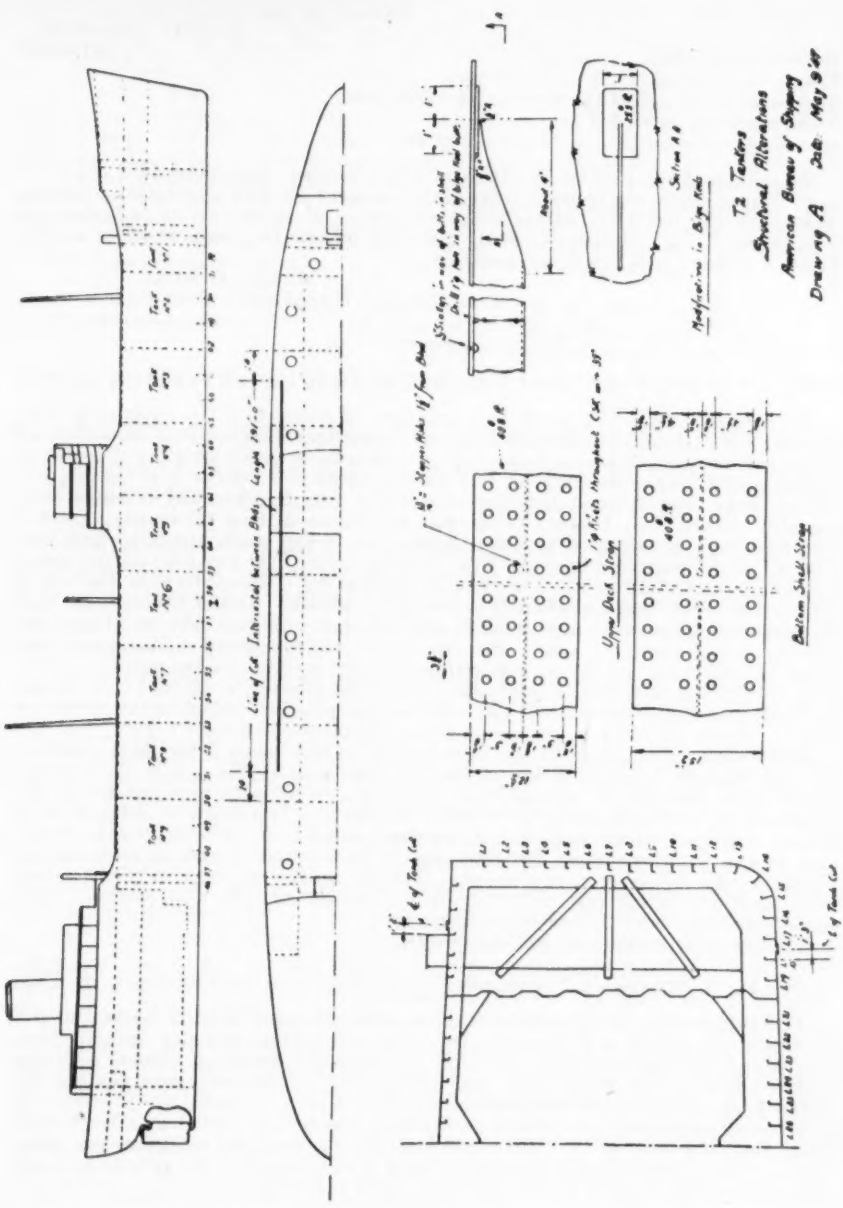
CODE NUMBER 5
U.S. COAST GUARD PLAN EMM17-311-17-1 ALTERATION "B"
WAR SHIPPING ADMINISTRATION PLAN MR 15-311-1
GIBBS & COX INC. CALSHIP MCE PLAN 1-312-311-6-4-4 ALT. XX
CODE NUMBER 6
U.S. COAST GUARD PLAN EMM17-311-17-1 ALTERATION "P"
U.S. COAST GUARD PLAN ML 15-311-17-1 DETAIL G
WAR DEPARTMENT PLAN L1-69-A-R DETAIL G
HURLEY MARINE WORKS PLAN ECB-37
CODE NUMBER 7---CUT OMITTED
GIBBS & COX INC. CALSHIP MCE PLAN 1-312-316-4-4A ALT. 1

## BILGE KEEL ALTERATION



CODE NUMBER 1 CODE NUMBER 2 CODE NUMBER 3

CODE NUMBER 1---AS SHOWN
CODE NUMBER 2
U.S. COAST GUARD PLAN EMM 17-311-17-1 ALTERATION "D"
ARTHUR G. BLAIR INC. PLAN 09A-33 DETAIL D
CODE NUMBER 3
U.S COAST GUARD PLAN MA-15-311-17-1 DETAIL D


T2 Tankers
Structural Alterations
American Bureau of Shipping
Drawing A Date: May 9 '44
Upper Deck Strap
Bottom Shell Strap

TREASURY DEPARTMENT,
UNITED STATES COAST GUARD,
OFFICIAL DISPATCH.

December 15, 1947. CG–MIN.302
From: Commandant (M). X Priority.
To (for action): ALDIST (dmi) except 2nd, 9th
Messengers to: 4–3 4–7

TEXT

T2 tankers X strengthen by fitting of crack stoppers according ABS specifications X place such requirement immediately against all T2's undergoing overhaul which are gas freed by withholding certificates of inspection or withdrawing certificates X T2's in operation may continue on one trip basis pending availability of repair yards X advise operators.

MERLIN O'NEILL,
*Rear Admiral, United States Coast Guard,*
*Acting Commandant.*

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CASUALTY OF STEAMSHIP "FORT MERCER" OFF CAPE COD ON FEBRUARY 18, 1952

On February 18, 1952, while in a position off Cape Cod the Steamship *Fort Mercer*, a T–2 tanker, suffered a series of fractures which resulted in the vessel being broken completely in half. The vessel was en route to Boston and was loaded about to her winter load line with a cargo of kerosene and heating oil. Cargo tanks Nos. 2 through 8 were essentially full, and the No. 9 tanks were partially filled. No. 1 cargo tanks and the forward deep tanks were empty. The first fracture occurred at about 8:08 a. m. in the starboard bilge area just forward of the bulkhead between Nos. 5 and 6 tanks. Oil was seen on the water and soundings indicated No. 5 wing tank was leaking. About 10 a. m. the upper end of the crack was sighted when the vessel rolled. At the time of the first fracture the vessel was turning 64 revolutions per minute. The wind and sea were very high, and the vessel was taking the weather broad on her port bow. After the fracture the speed was reduced to 45 revolutions per minute. The crew stated that at least one loud crack was heard during the course of the morning, indicating that the crack lengthened or that another section of the structure failed. About 12:15 p. m. the vessel broke completely in two.

Subsequent examination of the stern section of the vessel in drydock revealed that the fracture occurred in way of the bulkhead between No. 5 and No. 6 tanks, a few inches forward of the bulkhead on the starboard side, and just aft of the bulkhead on the port side. It is believed that the first fracture originated in way of a defective butt weld in the starboard bilge keel. The herringbone pattern on the fracture surface indicates one or more crack sources in each section between crack arrestors, and it appears that the cracks ran back to the arrestors from each side rather than running directly across into the next section. The vessel was fitted with four of these arrestors.

(Photographs on file with the committee.)

CASUALTY OF STEAMSHIP "PENDLETON" OFF CAPE COD ON FEBRUARY 18, 1952

On February 18, 1952, about 5:50 a. m. while in a position off Cape Cod the Steamship *Pendleton*, a T–2 tanker, suddenly and without warning broke in two. The vessel was en route from the Gulf of Mexico to Portland, Maine, and was loaded about to her winter load line with a cargo of kerosene and heating oil. Cargo tanks 3 through 8 were essentially full, and No. 2 and No. 9 centerline tanks were partially filled. The forward deep tanks, No. 1 tanks, and No. 9 wing tanks were empty. At the time of the fracture the wind and sea were very high. The vessel was proceeding at a reduced speed of 45 revolutions per minute and was taking the weather broad on the port bow. The sea water temperature was about 40° F.

A subsequent examination of the wreck of the stern portion of the vessel aground off Chatham, Mass., revealing that the starboard side of the vessel had broken just forward of the bulkhead between No. 7 and No. 8 tanks. The herringbone pattern of the fracture indicated that the crack had originated in the lower portion of the vessel and had run up the starboard side. Due to the position of the wreck an examination of the bottom and port side was not possible.

(Photographs on file with the committee.)

MARCH 20, 1952.

Subject: T–2 tankers, structural casualties.

AMERICAN BUREAU OF SHIPPING,
*45 Broad Street, New York 4, N. Y.*

(Attention Mr. D. P. Brown.)

DEAR MR. BROWN: With reference to our recent discussion as to means of improving the structural conditions on the existing T–2 type tankers, I am gratified to learn that this subject has been discussed in a preliminary way by the American Bureau of Shipping committee on naval architecture.

It is my understanding that the results of this preliminary discussion will be studied by the Bureau's main technical committee, and I will appreciate your keeping me advised of your findings in order that the steps to be taken by the Coast Guard to prevent further serious failures of these vessels can be integrated with the action to be taken by the American Bureau of Shipping.

Very truly yours,

H. C. SHEPHEARD,
*Rear Admiral, United States Coast Guard,*
*Chief, Office of Merchant Marine Safety.*

Senator MAGNUSON. You may proceed.

## STATEMENT OF REAR ADM. H. C. SHEPHEARD, CHIEF, OFFICE OF MERCHANT MARINE SAFETY, UNITED STATES COAST GUARD, WASHINGTON, D. C.

Admiral SHEPHEARD. Mr. Chairman, first of all, I concur in the statements of one whom we all have the greatest respect for his outstanding ability and feeling as his being an authority in the field, Admiral Cochrane. There is nothing in the report that is at variance one iota with his views.

The breaking in two of the war-built T–2 tankers *Fort Mercer* and *Pendleton*, with a loss of 14 lives, calls very sharp attention to the ship fracture problem.

The susceptibility of welded ships to extensive fractures has been a serious problem since early in World War II, when our shipyards turned to welding as the only means of fulfilling the task set before them of rapidly building enough ships to support the war effort which ultimately produced victory. By the adoption of welding a miracle in shipbuilding was performed and for the most part this miracle was performed by men and women recruited in great haste for shipbuilding.

The T–2 tanker *Schenectady* broke in two lying at the dock on January 16, 1943. This fracture, together with a number of less extensive fractures which had occurred in Liberty ships prior to that date, brought a full realization that serious problems were to be encountered as a result of the sudden transition from riveting to welding. The fractures which occurred were carefully investigated by the Coast Guard, the Maritime Commission, and the American Bureau of Shipping, and in addition, when the magnitude of the problem became apparent, the Secretary of the Navy, under whom the Coast Guard functioned at that time, appointed a board in April 1943, to investigate the design and methods of construction of welded steel merchant vessels.

This matter has been the subject of intensive study since that time. As the knowledge of the problem has increased, corrective means have been applied to the construction of new ships, and steps have been taken on the existing ships to improve their resistance to this type of casualty. The steps taken on existing ships have included the altera-

tion of certain details of the structure, such as the hatch corners on the Liberty ships, and the bilge keels on both the Liberty's and the T–2 tankers, as well as the provision of riveted crack arresters, designed to limit the spread of a fracture after its inception. The fitting of such crack arresters at both gunwales of the Liberty ships was completed by June 1947, and in accordance with an American Bureau of Shipping order, four such crack arresters were fitted to the T–2 tankers prior to December 1948.

The effectiveness to date of the alterations made on the Liberty ships is indicated by the fact that no complete failure of a ship of this type has occurred since 1944, and the number of serious fractures occurring in these ships has been very minor since the alterations were completed.

The situation with respect to the T–2 tankers is far less encouraging at the present time. The casualties of the past winter point to the need for further corrective action.

In determining the adequacy of ship structure, the Coast Guard is authorized by law to accept the requirements of the recognized American Classification Society, the American Bureau of Shipping, and in matters affecting the main structure it is the Coast Guard's policy to support the action of the American Bureau when that action is considered adequate. The rules of the American Bureau of Shipping for the building of steel ships have been carefully developed as a result of experience and technical knowledge, and all changes in these rules are carefully considered by the bureau's technical committees, on which are some of the country's leading naval architects, shipbuilders, and professors of naval architecture, together with representatives of the Maritime Administration, the Navy, and the Coast Guard. When unusual circumstances call for additional requirements on a class of ships, the bureau, after thorough consideration of the problem by the experts on these same technical committees, develops the requirements considered necessary for the vessels involved.

With regard to the T–2 tankers, reference has already been made to the order sent out by the American Bureau of Shipping in 1947, calling for four crack arresters.

Senator MAGNUSON. Do you mean in that case that they were only applied four to each ship or only to four ships?

Admiral SHEPHEARD. Four to each ship.

Senator MAGNUSON. Four to each ship?

Admiral SHEPHEARD. Yes. It was felt at that time that the measure proposed would provide the means of preventing complete failure of the hull and, that while fractures could still be expected to occur under some circumstances, the ships would be able to get into port. The failures of the *Fort Mercer* and the *Pendleton* have demonstrated that additional measures are necessary to obtain this objective, and the Coast Guard feels that the American Bureau of Shipping has again taken prompt action in the light of this additional knowledge.

The action of the American Bureau of Shipping will require the T–2 tankers to be provided with equivalent of four additional crack arresters, and the bilge keel attachment to the shell will be changed to a riveted connection.

Senator MAGNUSON. How was that attached before?

Admiral SHEPHEARD. Welded.

Senator MAGNUSON. You are going back a little bit to rivets?

Admiral SHEPHEARD. That is correct.

In addition, an increase in the longitudinal strength of the ship will be required, together with a manual of satisfactory loading and ballasting, both of which will bring about a reduction in the stress level in the main hull girder.

Senator MAGNUSON. I am not clear on my information, it is very general, but the point was made to me that there was too much distribution of the load too far forward and too far aft. Is that being changed?

Admiral SHEPHEARD. That is an improper distribution of the cargo, that is true. That provision that I have just mentioned here is aimed to correct that.

Senator MAGNUSON. In other words, they set down what they thought would be the correct distribution of the load?

Admiral SHEPHEARD. That is correct.

Senator MAGNUSON. Which will be different than what they had on those two ships?

Admiral SHEPHEARD. That is correct.

Statements have been published indicating that only a relatively small number of welded ships have been lost as a result of structural failures when compared to the very large number built. This is true from the point of view that the ships were built to do the job of winning the war, and this they did with only a minor percentage of casualties. However, from the point of view of safety, the Coast Guard feels that the loss of one ship is a matter of grave concern, particularly so when it cannot be said that all of the factors contributing to the loss are fully understood or recognized.

We know that we have learned a lot since 1943 when the *Schenectady* broke in two, but we also know that we do not yet have all the answers. The knowledge gained by experience, testing, and technical study, is being applied to the design and construction of new ships, and we know that the record of ships built since 1945 has been excellent, but we would be foolhardy to predict that this record will remain perfect in the future.

Senator MAGNUSON. The ships that cracked up, the *Fort Mercer* and the *Pendleton*, they were built prior to 1945, were they not?

Admiral SHEPHEARD. Yes, sir.

Senator MAGNUSON. And what about the one up in the Gulf of Alaska, was that a war-built ship?

Admiral SHEPHEARD. That is correct. There have been a total of 92 tankers that have come in pieces.

Senator MAGNUSON. They were all built prior to 1945?

Admiral SHEPHEARD. All wartime T–2 tankers.

Senator MAGNUSON. All war ships?

Admiral SHEPHEARD. That is right.

With respect to the ships now existing which were built during the war, including the Libery ships and the T–2 tankers, our position is not as good, since some of the improvements developed, as for example, improved steel specifications, cannot be applied to an existing ship.

Senator MAGNUSON. These ships have different steel specifications than the wartime ships?

Admiral SHEPHEARD. That is correct.

Senator MAGNUSON. Obviously, they could not be applied to a war-built ship, you would have to start all over again?

Admiral SHEPHEARD. That is an example of a number of other items.

For these ships the Coast Guard proposes to continue its program of careful analysis of any defects which develop, coupled with prompt action when the need for it is apparent. This, together with research programs to determine the fundamental causes of fractures of ships, should enable us to achieve the standards of safety desired on American ships.

Senator MAGNUSON. So you feel in general that although these unfortunate catastrophes have occurred that the present rules in the building of ships since 1945, with the changes due to the investigation, will, probably, forestall any such things in the future?

Admiral SHEPHEARD. For the vessels built since 1945 and for those built prior to that time the action taken by the American bureau will go a long way in preventing a reoccurence of these two disasters.

Senator MAGNUSON. It goes without saying that you are continually studying the problem?

Admiral SHEPHEARD. Right, sir.

Senator MAGNUSON. Thank you.

In 1944, June 20, there was an investigation in the House of plate fractures on welded ships by Congressman Jackson from my State. He made an interim report. They made certain recommendations at that time. One, improvement in welding procedures and practices. I suppose they have been taking place since 1945?

Admiral SHEPHEARD. Yes.

Senator MAGNUSON. Improvement in the quality of steel which you just testified to.

Admiral SHEPHEARD. That is correct.

Senator MAGNUSON. That you use for welding the steel itself that is used for welding. And they made certain suggestions as to design changes, but I suppose they would be very broad in their nature.

Admiral SHEPHEARD. They, too, have been made on these ships that have been built since 1945.

Senator MAGNUSON. In fact, it is a very excellent report. It predicts a great deal of these things that have happened with some of those ships.

Admiral SHEPHEARD. That is correct, sir.

Senator MAGNUSON. Thank you, Admiral.

Admiral SHEPHEARD. Thank you.

Senator MAGNUSON. I think there ought to be placed in the record, too, at this point one article in the New York Times of March 26, 1952, which points out that Lloyd's of London has approved the welding of vessels.

(The article referred to is as follows:)

[New York Times, Wednesday, March 26, 1952]

WELDING OF VESSELS APPROVED BY LLOYD'S

LONDON, March 25.—The welding process in maritime construction, under a cloud since two United States tankers with welded hulls broke in two last month, received an endorsement today in Lloyd's Register of Shipping

The statement of the corporation that originated marine insurance nearly three centuries ago concurred in this recent conclusion of the British Admiralty's Ship Welding Committee:

"Given sound design, good workmanship and tough steel, the reliability of welded ships is beyond question."

Much has been learned about the proper methods of welding in shipbuilding since the mass production of welded Liberty ships and tankers began in the United States in the early days of World War II, Lloyd's statement said. In 1943 when the first failures occurred, research in the United States and Britain disclosed defects in detail design, and steps were immediately taken to remedy them, the statement continued.

Since World War II, Lloyd's has surveyed many hundreds of welded ships while under construction. The lessons of the earlier failures have been applied and the ships are giving full satisfaction the statement said.

Lloyd's Register, which keeps a sharp eye on shipping all over the world, stated flatly that "to date major failures have not occurred in welded ships built since 1945."

One reason given for the earlier failures was that some steel that would have been all right in riveted ships proved too brittle if welded, especially at low temperature.

In the view of Lloyd's even in the early days of welding the end justified the means because rapid production through welding was the only way of building enough Liberty ships and standard tankers to win the battle of the Atlantic. Failures of a few ships must be related to the figure of more than 3,000 delivered, the Register argued.

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Senator MAGNUSON. Now we will next hear from Captain Wright, Chief, Hull Design Section, Bureau of Ships, United States Navy.

Anything that you have to add we will be glad to hear from you on this matter.

## STATEMENT OF CAPT. E. A. WRIGHT, USN, CHIEF, HULL DESIGN SECTION, BUREAU OF SHOPS, WASHINGTON, D. C.

Captain WRIGHT. Mr. Chairman, my name is Capt. E. A. Wright, in charge of hull design in the Bureau of Ships of the Navy Department.

The Navy Department has 55 T–2 tankers which are sister ships of the *Pendleton* and the *Fort Mercer*. These ships are under the operational control of the Military Sea Transportation Service.

Virtually all of the MSTS ships are in class with the American Bureau of Shipping and have so been for a number of years.

MSTS opinion of the American Bureau of Shipping as a technical agency is one of confidence and MSTS in all probability will follow the solution to this problem as proposed by the American Bureau of Shipping.

Senator MAGNUSON. You have had no troube to date with your T–2's?

Captain WRIGHT. We have been very fortunate, sir, in some 108 ship-years of operation under MSTS in having no major structural failures.

Senator MAGNUSON. Have you had some cracks in them?

Captain WRIGHT. We have had some cracks of a minor nature, sir, not in the main hull girder to such an extent as to endanger the ship.

Senator MAGNUSON. Thank you, Captain. We appreciate your telling us what the Navy is doing on this matter.

Captain WRIGHT. Thank you.

Senator MAGNUSON. Now we will hear from Mr. Green, president, of the American Bureau of Shipping. And Mr. Brown, in order to save time, you might come up, too.

## STATEMENT OF WALTER GREEN, PRESIDENT, AMERICAN BUREAU OF SHIPPING, 45 BROAD STREET, NEW YORK 4, N. Y.

Mr. GREEN. I was going to speak for just a few moments on the general terms and turn over the actual technical details to Mr. Brown, who is senior vice president and technical manager.

I would like to say that I thoroughly concur in the comments that have been offered by both Admiral Cochrane and Admiral Shepheard.

The Bureau is constantly studying the problem. We hope that the art will continue to advance as it has in the past, and that each year we will be able to build better ships.

The steps taken by the American Bureau of Shipping have been taken in collaboration with the Coast Guard.

You, perhaps, realize that our rules for construction and classing of vessels and repair of vessels are developed by technical committees.

Mr. Brown will introduce, if you care, the names of the technical committees that have been examining this problem and who have dealt with it in this last week. Mr. Brown is prepared to submit to you instructions which are in the mails today to all owners of T–2 tankers as to the requirements which have been decided upon on April 1, by the technical committee.

Senator MAGNUSON. Of your organization?

Mr. GREEN. Yes. The data which he submits to you is in the form of a draft for presentation to you, being actually that which is going out in the mails. It is in the mails to the owners of all T–2 tankers.

Senator MAGNUSON. The result of this investigation that led to what is now going in the mails, did that occur as the result of these two sea disasters?

Mr. GREEN. The decisions to make a change, a further addition to the requirements that were already in effect in past years with respect to T–2 tankers, which you referred to in the past testimony, have been stiffened up and increased materially due to the fact that two ships a month ago proved somewhat conclusively that the precautions taken in the past were insufficient to meet all conditions of weather.

Could I, for the purpose of complete accuracy of your record, state this? I think there is a small misunderstanding between you and Admiral Shepheard on the question of the distribution of cargo. The distribution of cargo has a great deal to do with the strains imposed on the vessel due to loading.

You put it in the form of a statement that the vessels had carried too much weight at the ends. That is sometimes a desirable way to load them in order to reduce stresses.

So, I think, depending on the type of cargo carried, the nature and length of the voyage which influences the distribution of fuel weights, that statement should be modified. The correct distribution of the vessel to produce less possible strain means that sometimes it is much more favorable to have less weight amidships.

That is for the purpose of making your record entirely clear.

Senator MAGNUSON. We will now be glad to hear from you, Mr. Brown. You do not need to go into details, but I think we would be

glad to hear for the record, because this is now public, in general what changes you have suggested, or the American Bureau has suggested. This is on the T–2 tankers.

**STATEMENT OF DAVID P. BROWN, VICE PRESIDENT, MECHANICAL PROGRAM, AMERICAN BUREAU OF SHIPPING, 45 BROAD STREET, NEW YORK 4, N. Y.**

Mr. BROWN. It is on the T–2. As a result of the deliberations of the two committees which Mr. Green has already outlined to you, our committees started in reviewing all of the available previous information and the studies which we made of these recent casualties. They were submitted first to our Committee on Naval Architecture, and then to our main technical committee, at a meeting held on Tuesday this week.

The result of those deliberations was that it was decided that the T–2 type tankers ought to be provided with, at least, eight riveted crack arrestors.

Senator MAGNUSON. Eight instead of four?

Mr. BROWN. Eight instead of four, for each ship. These are to be spaced with due regard for the loss of intact plating resulting from a crack extending between any of the arresters. And that the attachments to the bilge keels to the shell are to be rivited. The bilge keels which presently are welded to the shell are to be removed and attached by riveting.

And that in conjunction with these alterations there is to be provided such additional effective longitudinal material as will result in a general increase of 15 percent in the longitudinal strength of the vessel.

The purpose of those alterations, the increase in the number of crack arresters, is following the original line of thought of providing some safeguards against some fractures which are quite uncontrollable as the result of the condition of materials from which these ships were built.

The thinking is that by lowering the over-all stress level some of these faults that are in these ships will be of less significance.

The removal of the bilge keel is in the direction of trying to eliminate inception of fractures. The bilge keel has proved to be one of the sources most liable to start fractures.

Senator MAGNUSON. That would mean that all of the fleets of T–2 tankers will now have to come in and get some work done on them?

Mr. BROWN. Yes, sir.

Senator MAGNUSON. I just ask this for information. Do you have a time limit on that, or do you let them come in when they may, or give them what they call a reasonable time?

Mr. BROWN. We have cited in the letter to the owners, and I will read a paragraph here [reading]:

> Service records of these vessels indicate that serious failures occur almost exclusively under the conditions of low temperature and heavy seas such as are encountered only in the winter seasons. However, it is felt desirable that the above alterations be taken in hand at the first convenient opportunity and that they be completed if at all practical prior to the next winter season. It is requested that you study these requirements and furnish us with a list of the vessels of this type owned by yourself, together with a tentative schedule for carrying out these alterations.

Senator MAGNUSON. So they would have during the summer months to get into the yards and get this done?

Mr. BROWN. Yes, sir.

Senator MAGNUSON. Thank you, Mr. Brown. We appreciate your coming. However, before you leave, let me ask you one more question for information. Do these new regulations apply only to American-flag ships?

Mr. BROWN. No, sir; any ships that are classed with the American Bureau of Shipping.

All of the United States-flag ships are classed with the American Bureau.

Senator MAGNUSON. That would be the Panamanian, too; would it not?

Mr. BROWN. Yes.

Senator MAGNUSON. We might be able to get them back in the country occasionally then.

Mr. BROWN. There is a possibility.

Senator MAGNUSON. For a period of time, at least.

Thank you.

I would like to say for the record that I am in receipt of a statement from Mr. V. J. Malone, president of the Marine Firemen's Union, 150 Broadway, San Francisco, Calif., which I would like to make a part of the record.

STATEMENT OF THE MARINE FIREMEN'S UNION, SAN FRANCISCO, ON THE SUBJECT OF WAR-BUILT VESSELS CRACKING

Recently this union had the misfortune to lose the steamship *Pennsylvania*, owned and operated by the Pacific-Atlantic Steamship Co. We had memorial services at each branch of the union on the west coast and, together with all west-coast unions, arranged to have a plaque placed in a prominent section of a Seattle cemetery as a memorial to the crew of this vessel.

This ship, formerly the *Luxembourg Victory*, last year was sold by the United States Maritime Administration to the Pacific-Atlantic Steamship Co., who renamed her the *Pennsylvania*.

On the voyage previous to the disaster the ship cracked badly. However, it made port safely and was repaired but not strengthened.

In January she went out once more into a very vicious North Pacific storm, sent in a few short messages that the ship was cracking up, and that was the last anybody heard from her.

A short time before, the Matson Navigation Co.'s C–2 freighter *Sierra* cracked badly in a storm off Coos Bay, Oreg., and only by good luck, good seamanship, and the grace of God did she reach port safely. The cracks were prevented from widening by the use of heavy chains and turnbuckles. After a short time in the shipyard, she was patched up and sent out again in regular operation.

During the seasonal storms in the North Pacific recently, two other vessels cracked badly and were repaired.

One was the R–2 refrigerator ship *Flying Scud*, operated by the Pacific Far East Lines of San Francisco in their fleet of chartered reefer ships which are the main factor in keeping our forces in the Far East war zone supplied with fresh meats, and fresh fruit and vegetables from the United States.

We have long maintained that such refrigerator vessels, going out loaded with reefer supplies, and coming back empty, and subject to the terrific hammering and pounding of the North Pacific winter gales, would be bound to crack unless their hulls were strengthened.

The second was the *Bartlesville Victory*, operated by Pope & Talbot for the Military Sea Transportation Service. She was badly cracked, was put in the shipyard, repaired, and sent out again.

Under similar circumstances we had the *Joplin Victory* crack up on the Atlantic coast. She was operated for the Military Sea Transportation Service by the Pacific-Atlantic Steamship Co.

The *Battle Creek Victory*, assigned to American-Hawaiian Steamship Co. under charter to the intercoastal trade, also was in the shipyard for the same trouble, being welded up again.

Sometime ago we had the Liberty ship *Simon Benson*, which was operated by the firm of Sudden & Christenson, crack wide open in the Pacific. She returned to port safely, was repaired by the company, and then promptly sold.

We also had the Liberty freighter *Thomas Meagher*, operated by the Shepard Steamship Co. under general-agency agreements for the National Shipping Authority, which had similar trouble.

Besides this, we have the recent cases of the T–2 tankers *Fort Mercer* and *Pendleton*, and the NMU freighter *Helen Stephenson*.

The evidence is right there that many of our ships are simply floating coffins, and the first big storm they are asked to ride out will send them to the bottom. We hate the thought of attending any more dismal memorial services such as we had in memory of the men lost on the *Pennsylvania*.

What is the cause and what is the answer? They both lie in the fact that all the fearsome injuries of this type seem to be confined to butt-welded single skin ships. We propose that all such vessels be strengthened immediately.

Perhaps a simple, easily understood explanation of what happens might be cited by the simple job of tearing a dish cloth. You start a rip, and, whoosh, away it goes, and it is not checked until you come to the hem. Then you have to exert a lot of power, and sometimes have to cut the hem.

Thus, in an all-welded ship with a single continuous skin, once a crack starts in the hull, there is nothing to stop it. It just goes and goes. To stop this process on a ship, you either have to put in belts of riveted plates; or cut a seam along the side of the ship and weld plates securing both sides of the seam. There are other strengthening units needed, but this is a simple explanation of the process needed to make such ships safe.

The strapping, or strengthening, of currently operated ships is imperative.

It is also necessary that all ships being constructed in the future have alternate belts of riveted and welded plating.

The ships at present in operation, to be reasonably safe should have at least two belts of strengthening plates as used in the normal strapping process.

Another problem inherent in this matter disturbs us. Through such disasters, we get these problems, and we must have remedies for them. In the case of the *Pennsylvania*, no one can say with certainty when the men died, or even if they died. In normal circumstances, the master of the vessel has to sign a death certificate when a member of his crew dies at sea.

On the *Pennsylvania*, the master went down with the ship. A long and tortuous procedure then has to be gone through before the dependents of the missing or deceased man can be taken care of.

One of our men left a widow and five children; another a widow and three kids. The man's pay stopped immediately after the ship was lost.

Under our welfare plan, which covers our men with an insurance company, the beneficiary will get $3,000. Then, under the disaster rider in the war risk policy which we have negotiated with the shipowners, another $5,300 is payable—$5,000 for loss of life in a maritime disaster, and $300 for loss of clothes and personal effects. Finally, under social security, monthly pension payments should be forthcoming for the widow and children.

But in all three benefits, payments are delayed or road-blocked because we can get no death certificates, and progress in obtaining settlements depends almost entirely on the innate sense of justice and decency on the part of the underwriters. Yet, however fair-minded they might be about it, considerable time will elapse before these widows and children will get any funds from any of these three sources. It is even possible that in the case of some rugged insurance company have to wait seven years for some of this money.

We would suggest, to take care of such cases, that the Coast Guard or some suitable Federal agency, such as the Public Health Service, be empowered to issue certificates of presumptive death, after the Coast Guard had arrived at its findings, so that the claims on the insurance companies and the Social Security Administration could be speedily processed.

V. J. MALONE, *President.*

I might say for the record that I will put in the record a letter from the CIO Maritime Union on this matter expressing great concern because of the loss of their members on these two tragedies, and second

the psychological effect that it might have on the recruiting of men going to sea for fear that some of these ships may crack up. I hope that the testimony of these experts on the matter will allay those fears and help remedy the situation.

(The letter is as follows:)

NATIONAL MARITIME UNION OF AMERICA,
*New York, N. Y., February 21, 1952.*

Senator WARREN G. MAGNUSON,
*Chairman, Subcommittee on Merchant Marine and Maritime Matters,*
*Senate Committee on Interstate and Foreign Commerce,*
*Senate Office Building, Washington 25, D. C.*

DEAR SENATOR MAGNUSON: The membership of the National Maritime Union, all active merchant seamen, are alarmed over the increased foundering of merchant ships. The recent crack-ups of the *Flying Enterprise*, Isbrandtsen freighter, the *Fort Mercer*, a tanker, the *Pendleton*, a tanker, and the *Helen T. Stevenson*, all of which were manned by members of our union, did not founder in the same manner as vesseel built prior to the war that ran into similar western ocean storms during the winters. The *Pennsylvania*, another ship which went down with all hands in the Pacific Ocean, was another of these ships.

Seamen are accustomed to the general hazards of the sea, and have always recognized the dangers of their lives, and thousands of seamen lost during Wars I and II attest to their courage, but prior to World War II, when safety was not sacrificed in the interest of size, cargo capacity, and speed of building and turnaround, those ships were built to provide the strongest bottoms to meet the hazards of the sea.

In World War II, the seamen recognized and agreed that speed was necessary in building a fleet of vessels to deliver war materials to our allies, and our own forces throughout the world, and the development of the all-welded ship, which President Roosevelt at that time, classified as the "ugly duckling"—the Liberty ship, did the job that was required of them at that time.

However, it will be recalled that very serious crack-ups occurred during World War II. Congressional committees were made aware of the fact that over 300 of these vessels had cracked up in varying degrees, and some seamen's lives were lost, as well as valuable war material. As a result, hundreds of Liberty ships were then brought back into the yards, and riveted straps were placed on them to reinforce those vessels.

Now also a serious menace to the safety of crew and cargo develops from inadequate drydock repairs in which time and money are saved, at the expense of safety. From the early reports about the *Pendleton* crack-up, it appears that a better and more thorough job could have been done, when the ship was in drydock only a month ago, so that the ship might have withstood the pounding of the heavy seas.

Too many ship operators, overanxious to meet close operating time schedules, fail to allow adequate drydocking time to effect proper repairs and gamble on their ships not facing the kind of weather which cracked up the *Pendleton* and the other ships that have suffered a similar fate.

Unfortunately, the American merchant marine today, consists for the most part of the vessels built during World War II, and therefore, are in the main, all welded ships.

Most tanker vessels prior to the war, carried from 60,000 to 100,000 barrels of oil. The T-2 tanker and others developed during the war, were enlarged to carry upward of 150,000 barrels. Strength was naturally lessened by the expansion of this type vessel. They are no longer able to meet with the same degree of safety, the wintry seas, hurricanes, and typhoons, as were their predecessors, that carried smaller cargoes.

Seamen are concerned now, more than ever, because these vessels have now begun to reach the age where their seaworthiness becomes questionable. The riveted vessel was a seaworthy vessel in most cases, even after 20 years of operation. The welded ship, because of its rigidity, the lack of uniformity in welding and many other technical details, which we as seamen are not familiar with, does not have the ability to weather storms that the riveted ship had.

In the recent founderings, it will be established we feel sure, that these vessels broke up much faster than riveted vessels under the same circumstances, and but for the courageous and efficient rescue work of coast guardsmen, and other vessels, much greater loss of life would have occurred.

We know that during a war, it is necessary to make certain modifications and sacrifices of safety factors in the interest of winning the war, but if we are to have a strong peacetime merchant marine, there must be a reexamination of the whole welded-ship program. If our country is to be assured of having strong ships in time of emergency, as well as during peacetime, seamen will feel no trepidation in sailing.

Our Nation has still another stake in assuring safety and efficiency of American ships, because the taxpayers initially foot most of the bill in building the vessels, and subsidizing their operation in the competitive world shipping trade.

The National Maritime Union urges that a complete investigation be made by Congress of this whole shipping situation, particularly in view of the fact that there are now building the Mariner-type vessels, at taxpayers expense, which are intended to be the nucleus of our peacetime merchant marine shipping.

This congressional committee should also examine into the whole question of safety factors with regard to shipping, such as the loading of vessels, which has been speeded up in the past years to speed turn-arounds, installing of more safety equipment aboard vessels, such as the proposed radio transmitter for each lifeboat which in our opinion, had it been installed on the *Pennsylvania*, might have made possible the location of some of the lifeboats of that ship.

We believe such an investigation should be undertaken immediately to prevent further loss of life, weakening of the high morale of the merchant marine, and the American people's confidence in American shipping.

Respectfully yours,

JOSEPH CURRAN, *President.*

Senator MAGNUSON. That concludes the hearing on this particular subject.

(Whereupon, at 4:20 p. m. the subcommittee adjourned.)

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